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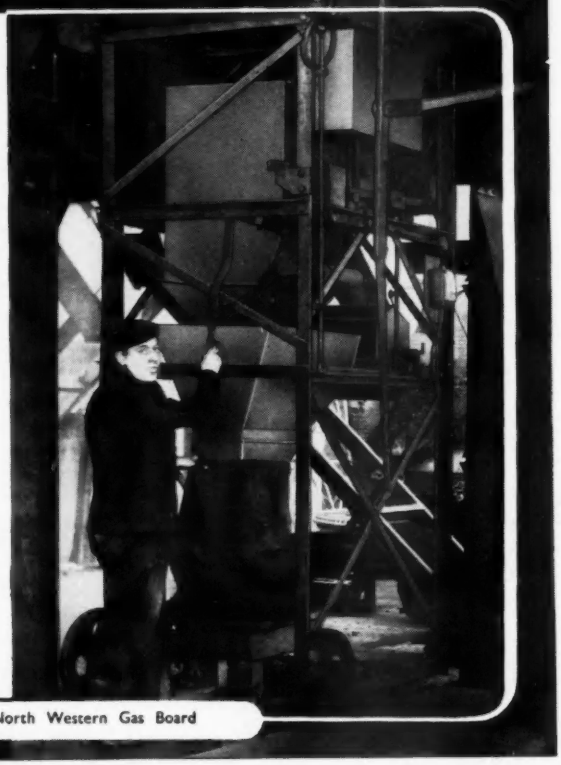

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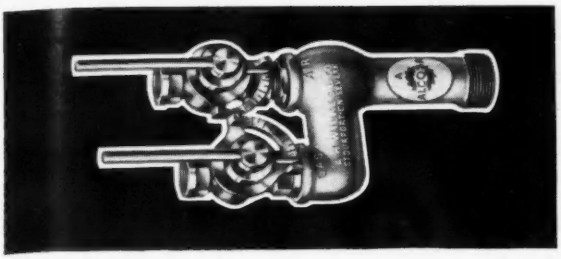

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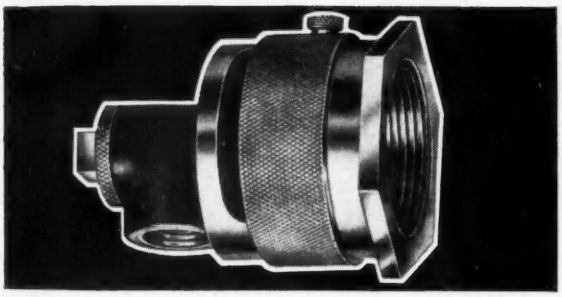

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Gas Journal

VOLUME 304 • NUMBER 5077 • 112th YEAR

WEDNESDAY DECEMBER 21, 1960

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Publishers' Notice, See Page 374, November 23, 1960

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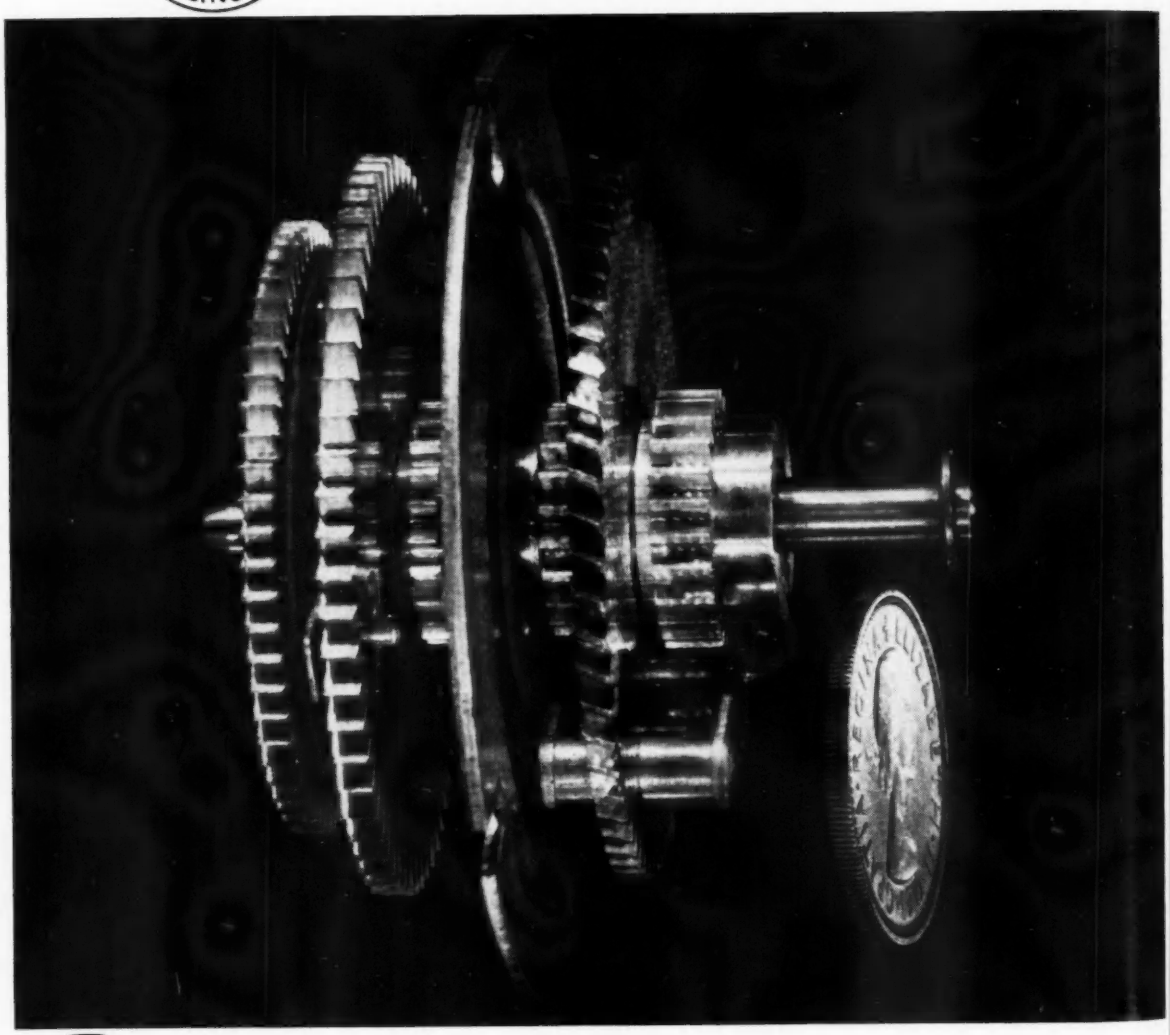

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Gas Journal

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From 'back-room' to front line?

IN the programmes of the Autumn Research meetings of the Institution, there are generally to be found papers of somewhat limited interest. This does not mean that these papers are not of interest in themselves, but that only a limited number of those taking part can really appreciate the finer points of the information revealed by the authors, or the real significance of the arguments brought to bear.

Those expert few who can put forward criticisms or additional points of interest arising out of such papers are generally to be found among the research staff of the Gas Council or the more prominent scientists working this week fall, we think, into this particular category.

The discussions of two papers which we are publishing this week fall we think, into this particular category.

Though they deal with completely different subjects, we feel that the intellectual approach of the authors in each case is similar. In both there is to be seen an exercise in analytical methods leading to the conclusion that not only can the outcome of certain chemical reactions be calculated from first principles, but also that accepted means of analysis may sometimes need an overhaul.

The first of these two papers comes from the firm of Distrigaz S.A. of Belgium, and the two authors, MM. J. Ribesse and C. van Maele, both engineers, are most ingenious in showing the possibilities of reforming hydrocarbons in an autothermic generator by purely theoretical means, followed by the description of such plants of their own design using methane and butane respectively.

A combination of pure physical chemistry and physics itself to calculate the reaction possibilities and the thermodynamic conditions of the reforming process, is most illuminating, and the fact that it has been put down in black and white for the ordinary gas engineer to read for himself does, we think, bring the research scientist out of his ivory tower, even though it may only be for a brief moment.

Such a display of expertise may only appear at these research meetings, but it can be safely assumed that these fundamental methods of analysis and the probing into the future possibilities of chemical processes are continually being practised by plant designers.

The back-room boy is likely to want to shun the glare of the searchlight of publicity and perhaps avoid the seemingly infantile questions of the interested layman, but to anyone wanting to know a little of the processes behind his ultimate success or the kind of problems he must battle with before the end is even in sight, papers of this type are a valuable insight. Added to this, the plant designed by the Belgians appears to be capable of a spectacular performance. It can be built for a price as low as £8,300 for an output of 1 mill. cu.ft. of gas a day, and its operating costs are as low as .2d. per therm; it is also extremely flexible.

The other paper we have in mind is the third instalment of an investigation into the composition of ammoniacal liquor by Dr. L. Barker and Mr. N. W. Hollingworth, both of the University of Leeds. In this paper the authors confine themselves to a discussion of the accuracy and suitability of the routine chemical analysis of ammoniacal liquor as practised in the area boards' laboratories up and down the country.

That these well-established methods should be questioned is of interest in itself even when they have been given the great prestige of such workers as Dr. A. Key in his book 'Gasworks Effluents and Ammonia,' but any such doubts bring out the importance which must be attached to modern analytical methods and the truly remarkable advances in laboratory aids and apparatus.

Means of detecting substances, hitherto unsuspected, or in far too small concentrations to be considered significant, has enabled the chemist of today to think once again on far more fundamental lines than may have been possible formerly. Traces of this or minute quantities of that substance may, in fact, vitiate some factor used in the calculation of his results. The analyst must return to first principles; he must make allowances for other substances of the same type present in quantities now measurable, and recalculate his factors.

In both these papers then, there is to be seen an approach to practical problems by the consideration of first principles. The calculation of conditions of opera-

We Wish All Our Readers A Happy Christmas

tion to reform a given gas to a suitable end product without the production of free carbon, and at the lowest possible operating costs is the kind of exercise chemical engineers may be constantly performing, but it is all too rarely that we get the opportunity of hearing about it in the gas industry. This and similar investigations indicate that our industry, though firmly on its feet, is at the same time on its toes.

Marriage of convenience

WE do not often refer to specific appliances in this column because to do so might leave us open to accusations of favouritism. But we have succumbed to the temptation of mentioning the new CannonLux without a pang, because this has the rare quality of being genuinely revolutionary in design. To the best of our knowledge it is the first-ever combined gas cooker and refrigerator unit, and is the result of a marriage of convenience (for this appliance only) between Cannon (GA) Ltd. and Electrolux Ltd.

Described as 'Specially styled for the family flat, bachelors of both sexes'—is this a nice way of avoiding the word spinsters?—'and anyone who wants the best of both worlds but finds space limited,' the CannonLux provides a standard four-burner hotplate and combined oven (a near relative of the Mighty Midget) and grill chamber, with a 1½-cu.ft. capacity refrigerator. The 'fridge takes the space normally occupied by the oven, while the oven/grill is at eye level. The removable grill slides into the top of the oven and a locking device prevents either the grill or oven burner being turned on when the other is in use.

Alternative specifications enable the appliance to be supplied with the Cannon Foldaway high level grill and an optional separate oven which can be fixed to the wall, or with a platerack over the hotplate and a combined oven and grill chamber for wall fixing.

The price of the basic unit, 72 guineas, appears to us to be excellent value, since in a sense this is not one appliance but two.

This is the third time Cannons have come up with a really new idea in recent years and we hope that the CannonLux will enjoy as much success as the eye-level grill and the GasMiser. The gas industry needs fresh thinking in the appliance field and it is good to see such evidence of ingenuity and co-operation.

Showroom for Basildon

NEW towns provide an effective testing ground for the popularity of gas. Here results can be assessed with relatively little interference from domestic consumers bringing their appliances from their previous homes. Happily the area boards in whose areas the new towns are situated have been quick to realise the importance of early contacts and hard selling. Results have been rewarding in terms of both domestic and industrial sales.

A good example of gas business built more or less from scratch is the new town of Basildon for which the North Thames Gas Board has laid 81 miles of main and provided services to 9,000 properties. Almost all of these houses have gas-ignited coke grates and in 7,584 (or just over 84%) of them housewives have chosen to cook by gas.

Sales of additional appliances have also been impressive. Gas in well represented in the 60 factories in Basildon and also in the schools, shops and churches; the latter employ warmed air systems as well as controlled convector heaters.

In spite of all this sales activity Basildon did not possess a gas showroom—until December 6 that is, when Lieut.-General Sir Humfrey Gale, K.B.E., C.B., C.V.O., M.C., Chairman of the Development Corporation, opened the ultra-modern establishment which will in future supply the needs of this growing community. This, the 93rd showroom in the area, is certainly one of the most attractive, the Board's Architect, Mr. T. C. Haynes, having met the challenge of providing a showroom for a new town with both imagination and the resources of a generous budget.

The showroom will be the subject of an illustrated feature in the January issue of *Gas Service*.

Ductair at Windsor

THE gas industry's steady progress towards the goal of a space heating load as large as, if not larger than, the cooking load, is progressing well. And it is greatly to the industry's advantage that it can advance on three distinct fronts. Room heater sales are building up nicely and sales of central heating boilers are extremely healthy. Ultimately, however, it may be the warm air heater which will provide the steadiest and most valuable load from the great mass of 'popular price' houses.

We recently inspected an installation of the kind which may prove typical of much domestic heating in this country. George Wimpey & Co. Ltd. have joined the ranks of the growing number of important builders interested in warm air heating by gas. In one of their houses at Hatch Lane, Windsor, can be seen the first example of the use by this company of the gas-fired G105/23 Ductair heating unit.

This unit is contained within a rectangular cabinet small enough to fit on a kitchen wall or inside a cupboard, with an output of 23,000 B.t.u. per hour, providing full heating for a living space of up to 5,500 cu.ft.; alternatively, it will give full heating for a smaller living space and background warmth for bedrooms. At Windsor the cabinet is fixed at high level in the kitchen and forms a very neat installation.

In a house of 1,000 sq.ft. floor area, insulated to the Egerton Standard of insulation, this appliance will provide background warmth throughout the house at all times and full heating up to 67°F., in the living area for eight hours per day for an annual fuel consumption of about 400 therms of gas. Warm air can also be directed to a clothes drying cupboard. In houses, flats or other locations where a conventional flue is impracticable, models are available for use with balanced flues (as at Windsor) or SE-Ducts.

Encased in a steel cabinet finished in stoved enamel, the unit consists of a gas burner, heat exchanger and an electrically driven fan. An integral governor and thermo-electric valve-type flame failure control, embodying overheat protection (manual reset), are fitted. Control is fully automatic.

Average installed cost of the appliance in a 1,000-sq.ft. house is from £95 to £135 according to length of ducting required. The makers state that running costs for space heating only would be likely to average £27 to £36 per annum. With gas water heating included by means of a suitable boiler, such as the Ascot multipoint or New World Circulyn, operating costs would be from £40 to £50. At Windsor water heating is provided by an Ascot balanced flue water heater mounted above the cooker.

26th I.G.E. AUTUMN RESEARCH MEETING

Hydrocarbon reforming

MR. VAN MAELE, presenting his paper, said: In recent years, larger and larger quantities of hydrocarbons have become available on the market; for example, natural gas, refinery tail gases, firedamp, liquid petroleum gas, light distillates, and various oils.

One of the principal utilisation techniques is the catalytic reforming process, which consists of partial oxidation of the hydrocarbon by oxygen (air), steam or carbon dioxide, in the presence of an appropriate catalyst. The reactions that take place are :

$$C_nH_m + n/_2O_2 \rightarrow nCO + m/2H_2$$
$$C_nH_m + nH_2O \rightarrow nCO + (m/2 + n)\,H_2$$
$$C_nH_m + nCO_2 \rightarrow 2nCO + m/2H_2$$

The products obtained from these reactions are principally composed of hydrogen, carbon monoxide and small quantities of carbon dioxide, methane, water vapour and nitrogen. They are suitable for the production of town gas, the synthesis of ammonia and of urea, and the reduction of iron ore.

Theoretical composition

In the first part of this paper are established the thermodynamic equilibrium conditions for the mixture of hydrocarbon, oxygen and steam. This enables us to know the theoretical composition of the reformed gas obtained and the reaction temperature in an autothermic system, *i.e.*, needing no outside heat.

Experimental and industrial results have been shown to be very near the calculated theoretical values, this being achieved by the use of highly active catalysts.

In the second part are given a few industrial operating results of autothermic generators, principally in the field of peak-load town gas production.

Let us consider a mixture composed of hydrocarbon, oxygen or air, and steam under a determined pressure.

We have to determine the reaction conditions—for example, the proportions of the constituents in the production gas, the temperature of reaction, the thermal efficiency and other factors. After a systematic theoretical study of the different mixtures possible, we can then determine the optimum conditions that have to be realised in order to obtain desired conditions in the gas produced, such as a high percentage of hydrogen, a small percentage of residuary methane, the maximum efficiency, the calorific values, and so on.

There are three conditions to be fulfilled: First, the total number of atoms of a particular element stays identical for the reactants and reaction products; this is the balance of matter; the products are to be found in quantities in accordance with the thermodynamic equilibrium constants —these are given on [p. 3], being expressed as a function of the quantities of the gas present.

Finally, we must have balance of energy, which requires equality between the energy introduced with the molecule of hydrocarbon and the energy given out by the products of reaction,

$$L_o + S_o + C_o = L_s + S_s + R$$

where L_o and L_s are the latent heats of the reactants and products of reaction. S_o and S_s are the sensible heats of the reactants, R is the losses by radiation and convection of the reactor and C_o is outside supply of heat.

An important point must be cleared up here: Free carbon is not always present in the reaction products; calculations can give negative values for f; in such cases, the equation $2CO = CO_2 + C$ has no meaning since there is no free carbon; we can then suppose f to be identical to o and cross out [equation 4].

An example of calculation will make it easier to develop the method. Let us take a mixture of CH_4, air, and H_2O at atmospheric pressure and determine the conditions of equilibrium when the preheating temperature of the mixture is varied. First we choose different temperatures within the probable area of the reaction—630°, 660°, 750° and 810°C. Then for each of these temperatures for which are known the values of the constants of equilibrium, we calculate with [equations 1, 2, 3 and 4], the characteristics of the reaction products.

On a graph [Fig. 1] with the abscissae graduated for enthalpy and the ordinates for temperature (°C) we trace the two curves $Q_1 = f(T)$, of which the values have been determined in the two cases $f \neq o$ and $f \equiv o$.

The exothermic reaction temperatures at equilibrium are now known; it is easy to ascertain other thermodynamic characteristics by interpolating between the values found at the temperatures chosen for the calculations of [Table 1]. This is how the values in [Table 2] were established. In this table, the temperature of 38°C, given in the first column corresponds to the temperature of saturation of the mixture studied for the pressure of one atmosphere.

The thermal efficiency is obtained by multiplying the calorific value of the final gas by the expansion and dividing by the calorific value of CH_4.

We have thus found the characteristics of the reaction

Presentation and discussion of the paper 'The Thermodynamic Study of the Reforming of Hydrocarbons and its Application to Autothermic Generators' by J. RIBESSE (Engineer) and C. van MAELE (Engineer), Distrigaz, S.A., Belgium.

for a predetermined mixture; we can in the same way construct other diagrams for Q_1 as a function of T corresponding to other possible mixtures of the reactants, at different air flows, for the same steam flow, or for different steam flows with the same air flow. We thus obtain families of curves and results enabling us to explore completely the possibilities offered, by the reaction of methane with air and steam.

Similar families of curves have been traced for the theoretical study of the reforming of other hydrocarbons, such as propane, butane, light distillates, with air, oxygen and steam at atmospheric or other pressures.

Winter—Summer

Since the second world war, variations in consumption of gas have become more and more important. The ratio between maximum winter and minimum summer consumption in Belgium exceeds 3, and is increasing rapidly from year to year. There are, moreover, the increasing daily variations. One thus sees the necessity for arranging means of producing peak-load gas, the choice of which must be based in the first place on economic considerations, on flexibility of operation, and on the quality of the gas produced.

The autothermic reforming technique fulfills these points perfectly; the economy of this process derives from its low capital cost, from its high efficiency and from the low operating costs.

The plant produces steam in excess of its own requirements, and needs very little upkeep. The efficiency of reforming is 92%; total efficiency—the ratio between calories made available to the distribution network and calories absorbed by the plant—is about 97%.

Flexibility of production is very great, as a generator can be shut down for a few days, with no intervention necessary, and its starting-up process is practically instantaneous. The output can vary between 20 and 100% of the normal.

The plants already in use in Belgium give a total daily output of 1.8 mill. cu.m. or about 63.5 mill. cu.ft.

In general, liquid petroleum gases free from organic sulphur are reserved for reforming; the crude l.p.g. used for enriching gas to the required calorific value may contain organic sulphur.

A new autothermic catalytic reforming process has just been tested in Belgium. This is based on the recuperation of the sensible heat of the reformed bases being pushed to a maximum. The mixture of hydrocarbon, oxygen and steam is brought progressively to a temperature near to the temperature of reaction by passing through recuperator checkers of special material. The reactions take place on the catalyst. The reformed gas then passes through a checker recuperator identical to the first, which absorbs the sensible heat of the gas. The process is cyclic; an inversion system changes the direction of the flow in the generator. The production is, however, continuous; the use of an intermediate gasholder is not necessary.

Heat recuperation is very high; the reformed gas at the outlet of the generator is about 50°C. higher than the temperature of the mixture at the inlet. Many advantages result from this, of which may be noted the very high reforming efficiency of about 98%; the reformed gas has a specific gravity notably lower, about .58 to .61, and a higher calorific value, about 2,000 to 2,200 cal. cu.ft. cu.m., or 210 to 230 B.t.u per cu.ft., and the robustness and simplicity of the installation, which has no high-temperature metallic circuits. The process steam has, however, to be provided separately. This plant has been tested with methane and butane and is now being tested with other hydrocarbons.

Dr. F. J. Dent, Gas Council: Reforming covers a range of processes. At the one extreme, there is partial combustion with air and, at the other, reaction with steam. The autothermic process described in this paper can definitely be regarded as of the partial combustion type. The process can be visualised as the passing of a mixture of hydrocarbon and air with or without a small amount of steam, through a nickel catalyst on which the hydrocarbon is gasified by partial combustion in the air. The primary function of the steam appears to be to control the ratio of carbon monoxide and carbon dioxide in the products so as to avoid carbon deposition. As the ratio of air to hydrocarbon increases above the theoretical amount, CO_2 is produced by combustion and there is less need for steam addition, but the catalyst assumes a higher temperature and thermal efficiency falls as a result of greater losses of sensible heat in the products. Increasing the steam allows the air supply to be reduced, to give a higher thermal efficiency, with the catalyst at a lower temperature and, at the same time, it reduces the tendency for carbon deposition.

The operation of these effects can all be seen in the curves of [Fig. 2] which, as the authors describe, are based solely on thermodynamic considerations, and, from what they say, they apply to the operation of large-scale plants now in use.

Reaction kinetics

This rather surprises me. The indications of thermodynamics are undoubtedly of fundamental importance in pointing to the final state to which reactions progress but they by no means tell the whole story, particularly in a system in which there are several reaction mechanism occurring. While the final state is laid down by thermodynamics, one has to arrive at it and, in doing so, one is very much concerned with the relative rates of the various reactions—that is, with the reaction kinetics.

I would therefore like to ask the authors whether the theoretical steam requirements given in the paper can be adhered to when using a hydrocarbon supply such as light distillate.

A diagram of the type of plant used is given in [Fig. 3] and some operating results for various feedstocks in [Table 3]. We realise first that the plant could not be much simpler. It consists of little more than a vessel containing a bed of catalyst with heat exchange between reactants and products, and operation is continuous to minimise supervision and, at the same time, allow the precise control which is possible when reactions are proceeding to equilibrium. The heat exchange results in

thermal efficiencies in excess of 90%, while the plant cost, at 1 mill. Belgian francs for 1,000 cu.m. per hour, or £8,300 per mill. cu.ft. per day, is certainly low. But the composition of the gas made by this simple version of an autothermic process has certain characteristics. [Table 3] gives the composition of the gas leaving the reformer with the hydrocarbons having been more or less completely decomposed, and one notices the relatively high nitrogen content.

A point which intrigued me here was that it was possible to preheat mixtures of hydrocarbons and air to reformer temperatures without interaction occurring. Perhaps this is due to the special material of which the checkers are made. Can the authors enlighten us on this matter?

Different aim

At Solihull, the reforming problem is being approached with a rather different aim in view. The intention is to develop a reforming process with low plant costs, suitable for erection in high capacity units for operation in conjunction with a pressure grid. In such circumstances there might be little opportunity for blending, and it is taken that the gas produced by the reforming process must be completely interchangeable with that from our sources.

An examination indicated that, except when the feedstock was methane, the problem could be solved by an autothermic process, without using oxygen, if three features were incorporated: First, the air requirements must be minimised as far as possible by thorough heat recuperation—a point which is, of course, stressed by the authors in the paper. Secondly, the air requirement is reduced still further by operating the reformer at a relatively low temperature so as to produce gas of town gas calorific value directly. By doing so, additional heat is obtained from the exothermic conversion of part of the hydrocarbon feedstock of methane. Thirdly, the gas density is reduced by incorporated CO conversion and CO_2 removal.

Plant costs, although increased, will still be relatively low if unit installations have capacities of 25 mill. cu.ft. per day or more. The net result is that, when the three features are used, a gas of 500 B.t.u. per cu.ft. from butane contains 40% of hydrogen and has a density of .46 as against the figure of .745 given in [Table 4].

Naturally, when the hydrocarbon feedstock is methane, no assistance can be obtained from the exothermic production of methane over the catalyst. For this reason, an autothermic process for methane really requires the use of air enriched with oxygen if the gas produced is to be completely interchangeable. The amount of oxygen needed can be minimised by good heat exchange, and, for a hydrocarbon such as methane, the highly efficient reformer described in the paper, if operated at pressure, might well be the solution.

Mr. G. U. Hopton Gas Council: The first part of the paper deals with the theory of thermodynamic equilibrium, and I would point out that the term 'latent heat' should read 'potential heat'.

When we come to plant results, there are many questions we would like to ask. For example, there is a point about the special mixer at the base of the generator. Some of us know the difficulties due to bad flow pattern of gases through catalyst beds, which leads to hot spots. It affects the catalyst adversely and gives bad working results. Anything about that special mixer would be of value.

With regard to the point about the nickel catalyst, nickel is not a particularly easy catalyst as regards the support where it is magnesia or alumina, but it must be remembered in a continuous process like this under reducing conditions one would expect a nickel catalyst to withstand conditions rather better than in a cyclic process.

To my mind, the most interesting part of the paper is the description at the end with regard to the new technique using regenerators. Dr. Dent mentioned this. Perhaps I can ask the authors what temperature is obtained at the outlet of the regenerator before passage through the catalyst, and does any reaction in fact occur in the regenerator? The results are not merely good, they are spectacular. We get a very high efficiency and the density of the gas is about .06 lower than that of the conventional autothermic reforming. Also, the calorific value is about 40 B.t.u. per cu.ft. higher. But the gases still contain a good deal of nitrogen and the specific gravity is high, so that interchangeability must still be carefully studied.

The costs given in the paper, converted to our units, as Dr. Dent has already said, amount to £8,300 for a plant of 1 mill. cu.ft. per day. This is so low that, if it is true, I would like to ask the authors, can you really buy a plant to turn out a mill. cu.ft. of gas a day for £8,300 or, if that is a silly question, at what size of plant does this rate of costs apply?

With regard to operating costs, we think the operating costs come out at .1d. per therm, and if the capital costs are as low as stated, then the capital charges will be another .1d. per therm, so, the cost of this gas-making process would be the cost of the feedstock calculated at 92 to 98% efficiency, plus .2d. per therm capital charges and operating costs.

Dr. M. J. F. Olden, South Western Gas Board: Examining the analyses given in [Table 3], it can be seen that the lean gases produced solely by reforming process possess a relatively high specific gravity, which, in itself, may not be increased when the gas is enriched by the addition of methane or liquefied petroleum gases. It would seem that, as far as the British gas industry is concerned, the product from the Distrigaz plants would lie between p.f.d. enriched and reformed water gas and producer gas, in the matter of gas interchangeability.

Another reformer

In the South Western Gas Board, in collaboration with the Woodall-Duckham Company, a study was made of another type of reformer, namely the Koppers-Hasche, which allowed for both cyclic and autothermic reforming of light petroleum distillates. As far as the production of a cyclic gas completely interchangeable with coal gas was concerned, a great measure of success was achieved. Unfortunately, as is often the case, the process was defeated by side considerations such as the removal of fly carbon, for which no satisfactory solution was found.

At this stage, I would like to mention that we were un-

successful in implementing the calculation principles discussed in the first part of the authors' paper, due to the complexity of the hydrocarbons produced during our work, and as a consequence, the very large number of reaction equations involved.

The Koppers-Hasche reformer involved only the use of air and a light distillate of specific gravity of .66. There was no catalyst and no steam involved in the reaction. I say that there was no catalyst advisedly, because we were not aware of any catalytic activity shown by the alumina tiles forming the core of the plant.

If one dismisses the grave disadvantages of autothermically reforming light distillates on the Koppers-Hasche plant, an efficiency of approximately 92% was achieved. The Koppers-Hasche autothermic process is well established across the Atlantic on a feed of butane and propane. It appears, therefore, that the catalytic process may have much to commend it over the non-catalytic process tried out in the South Western area.

In spite of the encouraging figures given for the use of light distillates in [Table 3], there is adequate lean gas available in the industry today, and if one is to operate a process such as this described to the maximum effect one presumably would require a hydrocarbon gas for enrichment. In certain areas this might prove embarrassing, but where refinery gases and methane are readily available, the Distrigaz process could bear very critical examination if it is decided to install any new peak load plant.

In conclusion, I must draw attention to the second line of the first paragraph in the summary. Herein lies the Achilles Heel of all peak load autothermic processes. If one could reform with oxygen instead of air, many, if not all, of the criticisms of the gas produced would disappear.

Mr. C. Ryder, South Eastern Gas Board: When producing similar curves as the authors have produced in [Fig. 2] for light distillates, do they take the whole range of light distillates, or take a typical member such as C_6H_{14} as a basis for their curves?

Another point of some importance is, when comparing theoretical results with practical results, the ability to assess whether equilibrium has been reached in the reactor. Have the authors found this to be the case? If regeneration is practised, the whole matter becomes much more complicated, because when the reactants pass through the regenerator, the temperature of the gaseous mixture is continuously altering; hence the equilibrium composition of the gases changes. This would also be applicable to cyclic plants, particularly with a deep catalyst bed such as is used in the Segas plant, where temperature differences within the catalyst bed prevent a theoretical assessment of the reaction temperature.

The question of the cost of gas produced by the Distrigaz process has already been pointed out by other speakers: I would commend the industry to consider whether the use of l.p.g. gases as feedstock would not be cheaper than making producer gas from coke.

Ammoniacal liquor

DR. BARKER: A certain amount of information has been gathered from the detailed analysis of liquors, so it was felt that it might be used in an attempt to improve some of the analytical methods that are employed at the present time.

Considering first monohydric phenols, the appendix to Key's 'Gas Works Effluents and Ammonia' suggests that these compounds be separated from the liquor by distillation of the aqueous solution—a process of steam distillation —and determined in the distillate from the amount of bromine absorbed from a standard bromate-bromide solution. The result is returned as 'phenol (C_6H_5OH)' either in g. per 100 ml. or ppm. It has long been known that the determination does not give a true estimate of the total monohydric phenols present in a liquor since the relative proportions of the different monohydric phenols was not known. The determined value would only be correct if phenol was the only monohydric phenol that was present, or if all monohydric phenols absorbed the same amount of bromine per gram. Relatively simple analysis, however, had shown that homologues of phenols were always present in liquors and also that bromine atoms appeared only to substitute in positions ortho- and para- to the hydroxyl group in the molecule, so that, whereas phenol itself would absorb three atoms of bromine, o- and p- cresols should absorb only two atoms of bromine, and 2,6-xylenol only one. This means that the factor required to give a correct result for total monohydric phenols in a liquor must be derived from the concentration of each phenol and its bromination equivalent.

Previously, it had not been possible to derive such a factor, but the chromatographic analysis of liquors described in a previous communication has enabled this to be done. Whether the factor thus determined would then be of any practical value would depend on its remaining constant for a given liquor whenever the sample might be taken. This requires that the relative proportions of the different phenols should remain practically constant even though the total concentration might vary. Moreover, if the factor is to be of universal application, it must also be

constant for a given type of liquor produced in any plant. It has been the object of the present investigation to discover if such a constant can in fact be obtained. It should be emphasised that whatever property of the phenols is used to determine total monohydric phenols—or total dihydric phenols for that matter—in a liquor, the factor that will be used can be expected to be dependent upon the relative concentrations of the phenols that are present, since it is unlikely that the property will be the same for one gram of every phenol.

Bromine equivalents

The procedure given by The Society for Analytical Chemistry involves reaction of the phenol with an excess of the bromate-bromide solution and, instead of the theoretical amount of bromine being absorbed, the amount was invariably in excess of the theoretical and was often not an integral number of atoms. It thus became necessary to determine the bromine equivalents of the monohydric phenols under the conditions of the test. Since variations are possible in the amount of bromine absorbed by a phenol under different conditions, it would be interesting to know how far the method used in this paper differs from those followed in other laboratories. Obviously some standardisation of the technique is necessary.

Calculation of the bromination factors for a number of liquors shows that an average value can be obtained which, for a given type of liquor, appears to lie within a reasonably narrow range of values. Thus, for 12 coke oven liquors, the limits were between $\pm 2\%$, and even with 30 liquors of differing types, the average value was between limits of no more than $\pm 4\%$. However, two factors are suggested to deal with different types of liquor. The value used at present to give the result in terms of phenol is 157, ignoring decimal places. The value now suggested for liquors from coke ovens and horizontal retorts is 165, and for other liquors 170. Hence, all estimates in the past will have been between 5 to 10%, too low, though the extent of the error will depend on the bromination procedure that has been adopted.

We consider that a better way to determine total monohydric phenols in a liquor is by ultraviolet absorption. For the determination of monohydric phenols, they are first separated from other constituents of the liquor by distillation of the aqueous solution, the monohydric phenols being volatile in steam.

Turning next to the section on permanganate values, determinations have been made of the permanganate values of many phenols in order to assess the extent to which the 'difference figure' could be ascribed to dihydric phenols. This difference has always existed in an analysis since the contribution of dihydric phenols to the total permanganate value could not be determined. Where it has been possible to compare the permanganate values of pure phenols obtained in the present investigation with values from other sources, it is rarely found that there is complete agreement. Often this is not worse than 5%, but there are instances where values differ by at least 10%.

This being so, it was decided to see what agreement could be reached with values at present accepted for inorganic ions. In the case of thiocyanate, exactly the same figure was obtained. A number of determinations were made on the thiosulphate ion, and results were very consistent, but the value was some 6% below that at present in use. Repeat determinations on sulphide gave a wider range of values higher than this. It would be useful if other laboratories would check the more important values.

Combining the permanganate values of the various constituents of a liquor with their individual concentrations in solution, the contribution of this calculated value towards the determined total permanganate value of the liquor has been obtained. Averaging the difference figures

Presentation and discussion of the paper 'An Investigation into the Composition of Ammoniacal Liquor: 3—Improvements in Routine Analysis' by L. Barker and N. W. Hollingworth, University of Leeds.

for about 30 liquors gives a value of about 600 ppm. From the accumulation of errors, it is possible that, for many liquors, the value is not significant, and indeed two difference figures were negative to the extent of 600 ppm. Moreover, calculated values are quoted to 1 ppm., whereas if they had been rounded off at each stage of the calculation to the accuracy that could be accepted, some values could not have been given to within 100 ppm. In the case of coke oven liquors, it would seem that the difference figure could be significant, and this would mean that there are compounds in liquors having permanganate values which have not been identified.

Mr. E. H. M. Badger, North Thames Gas Board: The effect of lead on preventing the volatilisation of catechol may not have been specifically stated before but would be expected to follow from the observation noted in the Alkali Inspector's 64th annual report that lead salts precipitate catechol from solution. It was for this reason that it was suggested in the 65th report that the use of lead carbonate for the removal of sulphide prior to the determination of the permanganate value of crude liquors should be discontinued. The substitution of zinc sulphate for lead carbonate avoids this loss of catechol and is now the standard procedure in the permanganate test.

End products

I feel that it is intrinsically better to use a method which leads to the production of definite chemical end products, as occurs when the bromine is not in excess, than to use one which produces very indefinite end products. The criticisms of the accuracy of the present method of bromination do not seem to me to be very well founded. The errors due to the burette readings, which incidentally are not doubled when there are four readings instead of two, must surely be related to the net amount of bromine used up, and it does not really matter if the back titration is

large or small. Losses of bromine vapour can be made insignificant by keeping the bottle stoppered except for the few seconds during which the bromate solution is being added. The real test of this method lies in the precision of the experimental results obtained and, in his letter to *Industrial and Engineering Chemistry* [reference 19], A. W. Francis quoted results for individual cresols and mixtures which were within ½% of the theoretical values. My own experience with known amounts of phenol and cresols confirms that high accuracy can be obtained by the present standard method of bromination.

A possible advantage of the over-bromination method is one that Dr. Barker brought out in his presentation. This is that the weight of bromine absorbed per gram of o-cresol is much nearer to that of phenol than in the standard method, and therefore variations from liquor to liquor in the ratio of o-cresol to phenol would not give rise to much inaccuracy when a constant factor is applied. There would, however, be inaccuracies due to changing proportions of the other phenols. Thus, relative to phenol, p-cresol only take up 70% as much bromine and 2,4-xylenol about 55%.

Phenols test

As regards the Folin Denis test for total phenols, the authors state that they have not made measurements of the colours produced by individual phenols with this reagent. We have done this for 22 different phenols at the Fulham laboratory, but I will not quote the results now. Resorcinol, catechol and three of the substituted catechols give higher colour intensities per unit weight than does phenol, and in general the determination of total phenols by this method gives a result about 10% higher than by chromatography.

In an endeavour to determine the nature of the residual compounds left in the liquor after biological oxidation, we have extracted the liquor with ether under various conditions in order to classify the compounds into phenols, acids, bases, and neutral oils. Determinations of carbon were made by the wet method on each fraction, and the results expressed as a percentage of the total carbon in the liquor. About 6% of the total carbon was contained in compounds that could not be extracted. The amount in the so-called 'humic acid' fraction was only .4%. On one occasion, the amount of humic acids appeared to increase after partial biological treatment, but it diminished again after further treatment. Our present evidence is that humic acids do not form a very significant proportion of the residual compounds.

When the same extraction technique is applied to biologically treated liquors, some compounds are obtained in each fraction, but it is clear that their nature has changed. This is shown by working out the ratio of permanganate value to carbon content for each fraction. Thus for the phenol fraction, the ratio is about 1.8 in the untreated liquor, which is in agreement with the figure expected from determinations of the permanganate value of individual phenols, as made by the authors and ourselves, and their known carbon content, but after biological oxidation, the ratio can be as low as .43.

We have recently acquired at Fulham Laboratory an electro-phoresis apparatus for the determination of organic acids. This method will be applied to liquors before and after biological oxidation and should help to identify some of the compounds that are still unknown.

Mr. G. W. Cherry, West Midlands Gas Board: The paper falls into three main sections.

1. *The determination of phenols*—both monohydric and polyhydric—is most useful, and for the various types of liquor saves a routine analytical laboratory a lot of work.

For the determination of monohydric phenol, we in the West Midlands have hitherto followed in principle the method quoted by Key. Warnings have come from various sources from time to time, however, about the distillation and bromination peculiarities of phenols, and we have done a little work on the determination of pure phenol by this method. The investigation into the distillation of catechols and oxidised catechols is interesting. The distillation procedure given on [pp. 11 and 12] is just what is wanted, and I have put it into effect already.

Mr. Badger recommends that monohydric phenols should be determined colorimetrically by 4-aminophenazone, total phenols colorimetrically by Folin-Denis reagent, and polyhydric phenols by difference, and he has shown that the various interferences and abnormalities in colour intensities by chance almost cancel each other out, and should, theoretically, therefore give approximately correct results. We have found, however, that with the liquors we have to deal with in the West Midlands—continuous vertical retort liquor—the dilution necessary is up to 5,000 times, and then experimental error and inaccuracies in apparatus make these colorimetric methods very unreliable for routine purposes, using junior staff—we find that the distillation and bromination method gives us the most reliable results for our particular liquors.

2. *Permanganate value.*—I would like to suggest that the permanganate value does not give a very realistic figure and that it should be abandoned in favour of a better oxygen absorption method. I have in mind the dichromate value. We in the West Midlands have done a considerable number of dichromate value determinations on gas liquors, and can produce figures which indicate that *complete* oxidation occurs—except for nitrogen compounds and those yielding nitrogen gas.

Oxygen content

The dichromate value plus correction for nitrogen—determined in the SCN′ and NH_3 analyses—gives an ultimate oxygen demand in very close agreement—in many cases identical—with the ultimate oxygen demand calculated from the CNS and H contents of the liquor. We often calculate the ultimate oxygen content of a liquor as dichromate value plus 3.75 times ammonia content.

Returning to the permanganate value, the difference figure of 660 ppm. unaccounted for, if significant, could possibly be due to neutral unsaturated compounds—ethylenic or acetylenic oils from tar. The authors say that, in this work it was arranged that 10 to 15 ml. of permanganate were used. We have always worked it so that as near to, and not more than, 50% permanganate is used up. We can confirm that chloride increases per-

manganate value—but not if 25% phosphoric acid replaces sulphuric acid in the test.

3. *The determination of total phenols by U.V. spectroscopy.*—I am not fully qualified to comment here, since we have only just acquired a U.V. spectrophotometer, and are still learning how to use it. We have some experience in the paper of chromatographic separations of phenols in liquor. The factors determined in this section are again of great use.

There is no mention of the Bunte method for the determination of higher tar acids. Could we please have an official recommendation that this be abandoned? I am sure that the method tells us nothing at all, but some engineers still ask for the figure.. The Aldridge colorimetric method for SCN′ is mentioned. I understood that this method was not now favoured since it used benzidine, a proved carcinogenic substance. We now use the pyridine-pyrazolone method, which gives very satisfactory results. We find Key's H_2S and S_2O_3'' methods adequate for our purpose, but it is agreed that they could, with advantage, be improved.

Dr. A. C. Monkhouse: As I have been connected with this work from the very beginning, I would like to express great appreciation of the progress made by Dr. Blackburn and his staff, as indicated by the paper by Dr. Barker and Mr. Hollingworth. When we started, we had a great advantage, in so far as Mr. Linder, who is the assistant to the Chief Alkali Inspector, had worked on a number of methods, and we therefore had something to go on. We did know a little why we did these things but you had to be very careful, and I agree the phenol method, particularly where we used a dihydric phenol method, was one which required a little care. We knew nothing then about the composition of monohydric phenols and, in particular, of the polyhydric phenols. We rather assumed it was mainly catechol and adopted a method of oxygen absorption. We did get a measurement because, presumably, the darkening of the liquor was rather important. So much progress has been made since then.

I would like again to pay tribute to the work of Mr. Linder in the original instance, and I would like to say how much I appreciate the progress that has been made by chromatography and by U.V. spectroscopy. The progress has been great and we know so very much more. There are so many things in ammoniacal liquor that I am afraid it will take a long time before we know all of them.

BOOK REVIEW

GUIDE TO RUBBER SPECIFICATIONS

A short 'Guide to the Drafting of Specifications for Rubber Products' has been published by the Federation of British Rubber and Allied Manufacturers. A Federation Specification Advisory Committee was set up to examine the problem and devise means whereby the wide range of technical knowledge and experience now widespread in the rubber manufacturing industry might be made more fully accessible to designers and users of rubber components in other industries.

The Guide has been compiled as a first step towards rationalisation. It gives advice on the kinds of test most useful for performance testing (by the user) and quality control testing (by the manufacturer), and on the dimensional tolerances appropriate to different kinds of rubber component. It recommends the use of British standards wherever these are available and suitable for the purpose required, and especially of standard tests as set out in the various parts of B.S. 903.

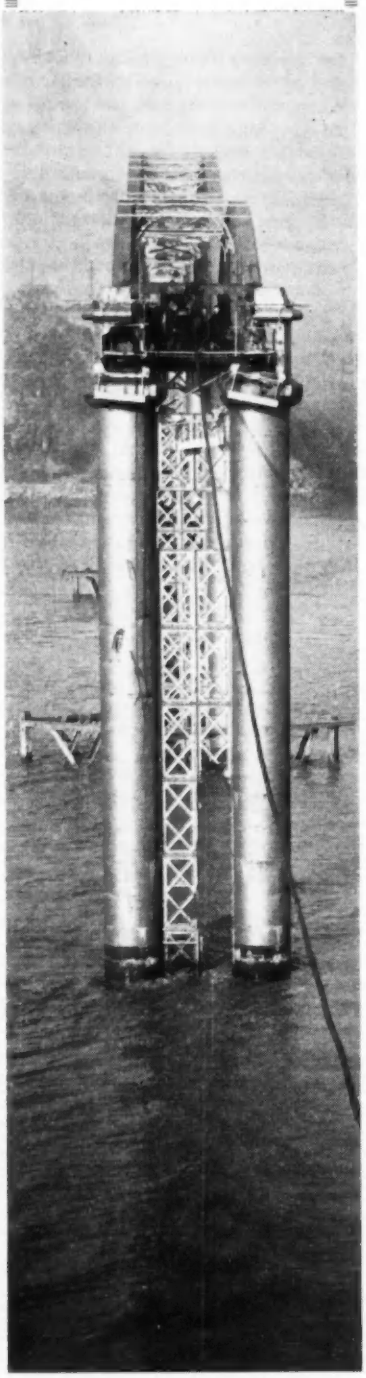
Above all it emphasises the importance of consulting the rubber manufacturer—or at least some qualified rubber technologist—at the earliest possible stage in the design of a new component or the drafting of a new specification. He can ensure that the properties most vital for the particular application are given due priority, and that the tests prescribed are practical, effective, and adequately related to ultimate performance.

Situations frequently arise in which a slight modification in design will enable a standard form of bush, seal, mounting or coupling to be used with considerable saving in trouble and expense; or it may be possible by a slight modification in the shape of a component considerably to reduce the cost of manufacture, and improve the ultimate performance.

To facilitate the necessary exchange of information between user and manufacturer, the Guide is accompanied by a series of questionnaires, indicating in detail for each different category of rubber product the information on function, properties, and service conditions which will be needed for the drafting of an up-to-date, practical and effective specification.

Copies may be obtained free from the Secretary, Federation of British Rubber and Allied Manufacturers, 43, Bedford Square, London, W.C.1.

ACROSS THE GAP



View across the gap from the Sharpness side as the tube is hauled over.

Operation Missing L

THE story of the fog mishap involving two oil tankers and the Sharpness bridge across the River Severn must, by now, be familiar to all. Two spans of the bridge were demolished, taking with them a section of the 12-in high pressure gas main. This supplied gas from the South Western Gas Board's grid mains to the Forest of Dean area.

Here is the engineering story, telling how the problem of restoring the supply of gas was overcome by slinging a light flexible pipe, supported by a steel cable, across the gap. The mishap occurred late on October 25. By November 11 all the Forest mains and gasholders were again in normal operation.

A little over a fortnight had elapsed since the disaster, but much had been accomplished.

The whole operation was based on planning, which, however sound, was done in a hurry and might even have included an element of optimism.

Nothing was committed to paper, no drawings made, no orders placed, except verbally.

A war-time spirit had been revived and everyone concerned responded to the emergency—it was a fine example of trust and good faith between engineers, whose only introduction to each other had been the job on hand.

HIGH LEVEL

The Sharpness bridge is about 101 ft. above low water level, and was opened for traffic in 1879. It is a wrought iron structure, approximately ¾-mile long, consisting of 14 spans each 134 ft. long, five spans each 171 ft. long, and two spans over the main river channel each 340 ft. long

The smaller spans are carried on piers of two cast iron columns 6 ft. in diameter filled with rough concrete. The large spans are supported by four similar columns 8 ft. in diameter.

The site is very exposed and south westerly gales up to 80 or 90 miles an hour, and up to ten-knot river currents are experienced.

12-in. MAIN

The 12-in. gas main was laid in 1955 with the full co-operation of British Transport Commission, and the several small gas producing stations in the Forest of Dean have been closed progressively since that date, the last being the Lydney works at the end of March 1960.

In the darkness and fog at the time of the accident little could be done but to close valves at each end of the bridge and to reduce pressures on the low pressure distribution systems in the Forest to the minimum level to ensure the safety of the gasholders in the area. These, at the time, would be about their lowest after the day-time load.

At daybreak senior officers of the South Western Gas Board inspected the damage, and it was quickly realised that the only hope of an early resumption of gas supplies lay in the possibility of slinging a light flexible pipe across the gap, supported by a steel cable.

Owing to a damaged pier, the span between any safe anchorages for this purpose was 546 ft., allowing for the parabolic curve of a cable with a maximum drop of 50 ft. from the horizontal.

Preliminary calculations showed that this was a feasible engineering proposition—although, as far as was known, one without precedent.

Advice was sought from bridge engineering specialists, from plastic pipe manufacturers, and from civil engineering contractors who all gave their immediate and unstinted aid.

The following morning—Thursday, October 27—a conference was held on site attended by senior engineers of the Cleveland Bridge and Engineering Co., Ltd., William Press and Son Ltd., British Railways and the Board, and Operation Missing Link began.

BY TELEPHONE

Detailed surveys and calculations were completed on the following day, and orders placed—by telephone—for all the materials, equipment, transport and manpower required.

During the weekend the special steelwork was fabricated. This consisted of an anchor beam to be fixed to the main arch trusses of the bridge span on the Severn Bridge station side, a beam forming an outrigger extending 10 ft. outside the main trusses of the last sound span on the Sharpness side, and a further beam, similar to the one on the other side, to accommodate a snatch block to guide the hauling rope back on to the centre of the bridge.

Powerful winches would be required at each end of the gap for paying out and hauling in the cables, with forward and reversing drive capable of being operated at very slow speed and with a drum capacity of 1,000 ft. of steel hawser.

Two special Fordson Major diesel

Link

FINE RESPONSE TO EMERGENCY BY ENGINEERS

engined tractor-winches were eventually obtained for this purpose.

On advice from Yorkshire Imperial Metals Ltd., and Imperial Chemical Industries Ltd., it was decided to use a polythene pipe, 4½ in. outside diameter, with a wall thickness of $\frac{5}{16}$ in., weighing 5.4 lb. per yard, able to withstand a permissible pressure of 80 p.s.i.

This tube was manufactured in two days in two lengths—one 400 ft. long for the Sharpness side, and the other 300 ft. long for the Severn Bridge side—with flanged joints at each end.

STEAM TRAPS

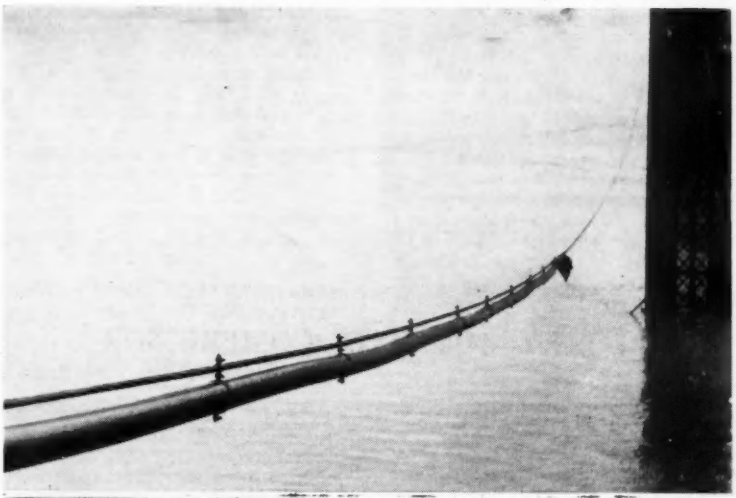
The flanged joints in the centre of the span accommodated a steel tee-piece carrying two Spirax thermodynamic steam traps to act as automatic syphons to discharge any condensate from the gas.

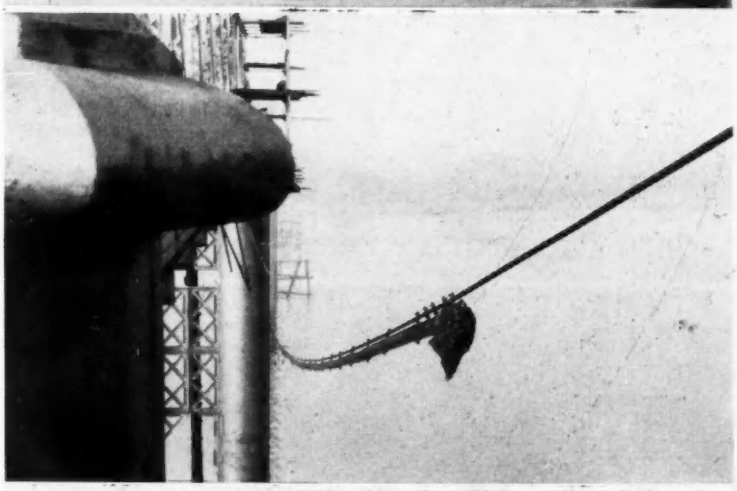
The lowest point of the tube is approximately 50 ft. above low water and 20 ft. above high water, and, therefore, completely inaccessible.

The method of supporting the polythene tube from the steel cable required much consideration. It was realised that in a gale the cable and tube would swing up to 30 ft. from its normal position, and that the wind loading would exceed the dead weight load.

It was necessary, therefore, to use a hanger firmly fixed to the tube, and the cable, to prevent the tube wrapping itself round the cable in a gale with considerable risk of damage.

The tube required support at 5-ft. intervals and 200 special clips were made for this purpose.





IT'S THERE . . .

Top picture: The tube starts its journey acros the gap—view from the Forest side. Centre: It nears the Sharpness side of the bridge. Bottom: The tube arrives on the Sharpness side.

This essential consideration brought another problem—that of 'spin' of the cable when tensioned. It was decided, therefore, to use a cable twice the length of the gap and submit it to all the working tension required before attaching the tube, and to maintain such tension throughout the whole operation.

It was planned to haul about 600 ft. of cable across the gap, leaving another 600 ft. on the Severn Bridge side to which the tube would be attached as this section of cable passed the snatch block on the anchor beam as it was being hauled to the Sharpness side.

Hauling was therefore done in 5-ft. lengths to allow the tube clips to be attached to the cable under tension.

A maximum loading of 7 tons was calculated, and a 1-in. diameter flexible round strand rope was selected, weighing 160 lb. per 100 ft., and consisting of a hempcore with six strands of 37 wires each, with a breaking load of 34 tons.

Access to the scene of operations could only be gained over the railway track—nine tenths of a mile on the Sharpness side and three tenths of a mile on the other from the nearest roadway, and the only way round the gap entailed a road journey of about 40 miles via Gloucester.

In spite of everything, by Wednesday morning, November 2, all the men, materials and plant had been assembled and by the end of the following day all the materials and plant had been pushed on plate-layers' trolleys out to the ends of the gap.

ANCHOR BEAMS

The steel anchor beams and outrigger were erected on Friday, November 4.

On Saturday morning the tractor-winches mounted on 'Weltrol' railway wagons were shunted by loco on to the bridge, the last stages of their journeys being completed by hauling themselves along with their own winches, because of the restrictions on using locomotives anywhere near the danger zone.

At 1 p.m. a manilla rope left the Sharpness side by a small outboard motor rowing boat—the only craft available—and was picked up on the other side.

This was used to haul a ⅜-in. diameter pilot steel wire across the gap and, repeating the operation, this was used to haul the main tractor hauling cable.

By 5.15 p.m. this was tensioned, and all was set to haul the main cable early next morning.

ALL WENT WELL

It was not until 11.30 a.m. that haulage of the main cable could commence, but then all went well and this operation was completed by 1 p.m.

At 3.30 p.m. the first length of polythene tube was launched from the Severn Bridge side and 300 ft. was hauled out before darkness stopped operations.

On Monday morning, November 7, work continued and by 1 p.m. the end of the tube reached the Sharpness side, and by nightfall the whole length was almost in its final position.

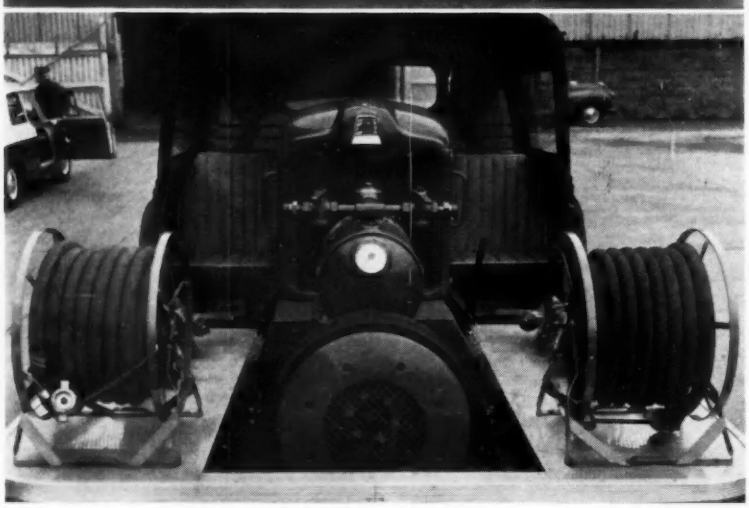
Dense fog next morning caused a delay of 1½ hours, but by 3 p.m. the main cable had been securely anchored and connections made between the polythene tube and ends of the 12-in. gas main on each side.

Purging of the mains then commenced and the first gas consumers in the Forest received a supply early on the morning of Wednesday, November 8.

By Friday, November 11, all the Forest mains and gasholders were in normal operation.

Co-operation and assistance was given by the British Transport Commission (District Engineer's Department, Gloucester), the Cleveland Bridge and Engineering Co. Ltd., William Press and Son Ltd., Yorkshire Imperial Metals Ltd., Terrell's Wire Ropes Ltd., L. J. Eve Construction Company.

LORRY-MOUNTED COMPRESSOR



A light, manoeuvrable lorry-mounted compressor has been designed for the needs of the Southern Gas Board's Distribution Department. The vehicle is basically a Ford 15-cwt. chassis, modified by Powertruc Ltd.

The principle of the drive is unusual in that instead of having a light lorry with its own engine, from which the compressor is driven when required through a power take-off, in this case there is no lorry engine and the lorry is driven by means of power tapped from the normal compressor engine through a power take-off.

From the body design point of view it will be noted that the two extra crew men are comfortably and safely seated in the rearward extension of the cab (lower picture); the hoses are properly mounted on hose reels; the tools are safely strapped down in specially made cradles and on each side of the vehicle is provision for three standard lengths of service pipe.

Provision has been made for the standard lengths of pipe by cutting away the cab doors as illustrated in the top picture.

The space which the original lorry engine would have occupied is now neatly filled in with a radio set for control from headquarters.

NEWS SUPPLEMENT

Board changes imminent

DIAMOND TO RETIRE— MINISTER APPOINTS LEACH SUCCESSOR

- **MR. G. le B. DIAMOND, Chairman of the West Midlands Gas Board, will retire on July 31, 1961.**
- **MR. C. H. LEACH, at present Chairman of the Southern Gas Board, will succeed him.**
- **MR. A. F. HETHERINGTON, who is Deputy Chairman of the Southern Gas Board at the moment, will become its new head.**

These three forthcoming moves have been announced during the past week by the Minister of Power.

MR. DIAMOND, who is 67, has been Chairman of the West Midlands Gas Board since nationalisation of the gas industry in 1949.

He has been a member of the armed forces, an engineer and an administrator.

HIS DESIGN

Mr. Diamond's long connection with the gas industry began with a civil engineering pupilage. He joined the Brighton and Hove Gas Company in 1919 and, while still a young engineer there, designed retort settings that were in use until recently. More than 40 years later he drew on experience gained in this task to re-design the first gas-fired, multi-passage kiln for the pottery industry which has resulted in it becoming an outstanding success.

For a time Mr. Diamond was at York gasworks as an assistant engineer, but later returned to South Eastern England, where he eventually took charge of works at Folkestone, Dover, Deal and East Kent.

When the first of the big gas holding companies was formed in 1933, with the late Sir David Milne-Watson at its head, Mr. Diamond became a member of the organisation and was eventually a director of 16 of the 30 gas companies.

WAR EFFORT

When war broke out in 1939, Mr. Diamond was seconded to the Ministry of Mines and then the Ministry of Fuel and Power.

He became the Ministry's Regional Controller in the South Eastern Region.

A wartime job was the co-ordination of work on the laying of the famous fuel pipeline, Pluto, across the region as far as the coast. For this and other services to the country, Mr. Diamond was awarded the C.B.E.

The West Midlands Gas Board led the country in plans for the erection of a Lurgi total gasification plant in 1951, but because of eight years delay over planning difficulties, the honour of putting the first such plant into operation went to the Scottish Gas Board.

The West Midlands plant is now in course of erection at Coleshill.

Outside the gas industry, Mr. Diamond was for 14 years Chairman of the Golder's Green and Woking Crematoria Company and he is the designer of the Diamond cremation furnace.

Mr. Diamond has served on several Government and other official bodies.

He is a past-president of the Southern Association of Gas Engineers and Managers, a former member of the Council of the Institution of Gas Engineers and an Hon. Fellow of the Institute of Fuel.

He is a Director of Midland Tar Distillers Ltd. and serves on the Council of Birmingham Chamber of Commerce in addition to a considerable number of technical and other associations connected with the gas and fuel industries.

Mr. Diamond is not only an accomplished cabinet maker, but has a variety of hobbies including electronics, painting, literature, and gardening. He and his wife have their home at Shorne, in Kent.

MR. LEACH has spent his career in the gas industry and prior to nationalisation was General Manager of the Liverpool Gas Company.

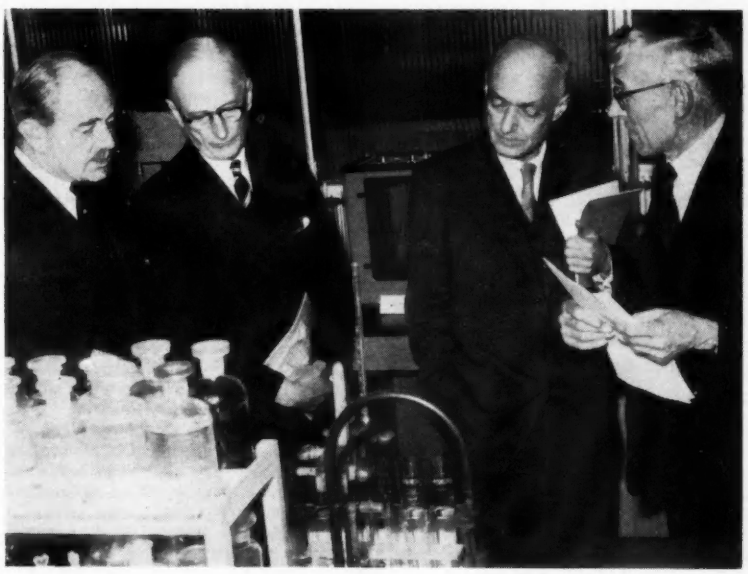
Subsequently he became General Manager of the Liverpool Group of the North Western Gas Board.

He was appointed Chairman of the Southern Gas Board in 1956.

MR. HETHERINGTON has also spent his career in the gas industry and prior to nationalisation held various positions in the Gas Light and Coke Company.

Subsequently he became a Divisional Manager in the North Thames Gas Board and later Commercial Manager, Southern Gas Board.

He was appointed Deputy Chairman of the Southern Gas Board in 1956.



Seen here inspecting the new central laboratories of the South Eastern Gas Board, in the Old Kent Road, after their inauguration recently by Mr. W. K. Hutchison C.B.E., *Deputy Chairman of the Gas Council and formerly Chairman of the Board are Mr. R. N. Bruce, the present Chairman, Sir Henry Jones* M.B.E., *Chairman of the Gas Council, and Professor Sir Cyril Hinchelwood,* O.M., F.R.S. *They are accompanied by Mr. W. F. Gardiner, a Senior Chemist of the Board.*

Methane scheme now aids growing gas demand by many Midland industries

GRANVILLE COLLIERY, near St. Georges, is the first in the South Staffordshire and Shropshire area to be equipped for methane drainage. Exhaustion of gas from the top coal seam into the return airway started in April 1957, and after the drainage system had been expanded, a pipeline was extended to the surface early this year.

Meanwhile, the construction of a pipeline to Wellington gasworks, nearly six miles away, was in hand, and the supply started this October at the rate of about 1¾ mill. cu.ft. a week.

At Wellington gasworks the methane is diluted with blue water gas to reduce it to a calorific value of 450.

Blue water gas, enriched with methane, is further mixed with coal gas from the carbonising plant before passing through the purification system, from which the mixed gases emerge as refined town gas.

Blue water gas is normally enriched by the thermal cracking of quantities of oil. The supply of methane from the National Coal Board is therefore replacing this oil.

Demand grows

The increased amount of gas which can be made at the Wellington gasworks now that the scheme is operating will help to meet the growing demand for gas on the eastern side of Shropshire, where it is being used on a steadily expanding scale by local industry.

It will also help augment the domestic supply.

Of the total quantity of methane being drained at West Midlands collieries, 72% is being put to practical use, compared with a national average of 44%. Gas being drained in the division represents about 12% of the total national figure.

Although methane provides only about 1% of the gas made or purchased by the West Midlands Gas Board, it has nevertheless proved a most useful source of supply in North Staffordshire, where the demand for gas, particularly in the pottery industry, is breaking all records.

Pipe range

Methane drainage trials in the West Midlands Division started at Stafford Colliery, North Staffordshire, in 1951. The colliery's Bowling Alley seam had a high methane emission rate of the order of 2,500 cu.ft. per ton of coal mined.

The success of these trials led to the installation in 1953 of a pipe range from the coal face to the surface, where exhauster pumps drew out the gas.

The methane was used for a period for driving a gas turbine—an experiment undertaken jointly by the Ministry of Power and the National Coal Board.

Later, the gas was used for steam-raising in the colliery's boilers.

Working of seams at Wolstanton Colliery, North Staffs., was hindered for many years by a high methane emission, which has been as heavy as 2,500 cu.ft. per ton of coal mined.

A drainage system was installed in 1955, and two years later the first scheme in the division for supplying methane to the West Midlands Gas Board came into effect.

By September of that year it was being piped to the Etruria Gasworks, Stoke-on-Trent, at the rate of 2 mill. cu.ft. a week.

Output of methane from this colliery is expected to be stepped up considerably when a concentration scheme involving Deep Pit and Sneyd Colliery is completed.

Major problem

Methane emission has also been a major problem at Holditch Colliery, where a discharge as high as 3,000 cu.ft. per ton of coal mined has been experienced in the Moss Seam.

A drainage system, comprising 6¾ miles of pipes underground and exhauster equipment on the surface, was completed early in 1958, and later the same year a service pipeline was installed by the West Midlands Gas Board to link Holditch Colliery with the supply pipe from Wolstanton Colliery.

The quantity delivered to the gas board from Holditch and Wolstanton Collieries has since risen above 6 mill. cu.ft. a week, sufficient to supply some 25,000 homes.

Hem Heath Colliery, North Staffs., has been passing through a major reconstruction to improve productive conditions in workings at around 1,800 ft. deep, and to enable high quality coals lying at between 3,000 and 4,000 ft. to be mined.

A drainage system was installed at the start of the reconstruction, in the first place to remove relatively small quantities of methane from existing workings, but ultimately to serve the deeper seams to be opened up.

A pipeline was laid on the surface to feed the gas to Stafford Colliery for burning under the boilers, but a total of more than 3 mill. cu.ft. a week is now being supplied to the gas board from both collieries.

More than 2 mill. cu.ft. a week are now being drained by an installation at Chatterley-Whitfield Colliery.

Last year methane helped to make good a fall-off over several months in the amount of coke oven gas available to the Board.

Many switch

Although many pottery manufacturers have already switched from solid fuel bottle kilns to gas as a means of firing their wares, there are still many others who have to make the change.

Gas is also now being used for many ancillary processes connected with the pottery trade. There is every prospect, therefore, that the demand for gas will continue to grow in North Staffordshire.

In other parts of the Board's area, the use of gas for a wide variety of industrial processes is also growing steadily.

In Shropshire division, the many and varied uses of gas in industry include the production of fire clay, sanitary ware, paint drying, heat treatment and other engineering processes, baking, plastic curing, steam raising, chicken rearing and the broiler trade.

Methane taken from collieries in North Staffordshire by the Board would supply a town the size of Stafford, while that obtained from Granville Colliery, Shropshire, would supply a town the size of Owestry and Wem combined.

An alternative illustration is that North Staffordshire methane would supply 44,000 householders with their gas, and Shropshire methane another 9,000, making a total of 53,000 for the whole area.

NEW ZEALAND GAS SALES UP 2%

GAS sent out in New Zealand during 1959 exceeded 25 mill. therms, an increase of 2% over the previous year. There was an increase in the number of consumers for the first time since 1947, although it was a not very large increase.

Revenue from gas has increased by 4.2% and appliance sales showed a rise of 1.7%. As was expected, sales of by-products decreased because of the reduced demand for them.

East of Scotland Juniors visit Forth Bridge site

MEMBERS and friends of the East of Scotland Junior Gas Association visited the site of the new road bridge over the River Forth at Queensferry. The Deputy Resident Engineer gave a summary of the work that had been done, illustrated by drawings and photographs. After examining a model of the completed bridge, the visitors inspected the site.

On a following Saturday, the Association heard two papers. The first was given by Mr. R. D. Forrest on 'Distribution in the Border District,' which described the development of the border grid and gave details of routes and methods of mainlaying, together with notes on boosting, governing, and metering facilities.

The other paper was by Mr. E. Shiell on 'The Wiggins Gasholder.' This described the principles of operation and method of erection.

New Sahara pipeline

IN a new development, aimed at accelerating the exploitation of the Sahara's petroleum reserves, the French government has agreed upon the financing of a new pipeline from Ohanet, in the eastern Sahara, to the coast of the Mediterranean. Oil was struck at Ohanet last June. The new pipeline, which is scheduled for completion next year, should carry 1.5 mill. tons annually from next autumn.

Gas cleaning contract

A complete gas cleaning system contract to remove iron oxide fumes emitted during oxygen lancing of melting furnaces has been awarded by Midland Rollmakers Ltd. to Chemical Construction (G.B.) Ltd. This unit will have a capacity of 3,000 cu.ft. per minute and will be installed at Crewe. It is due to commence operating early in 1961.

Sales change

From the end of this year, Cochranes (Middlesbro') Foundry Ltd., will cease to operate as a separate selling entity. This announcement was made by the Stanton Ironworks Co. Ltd., following a review of its sales organisation. No other changes are involved and Cochranes will continue manufacturing its usual range of products. Staff involved in the change will be transferred to other duties at Cochranes, or to other companies within the Group.

Gas showrooms have, for a long time, concentrated on Mr. Therm's five-card trick—the traditional five domestic gas loads—of cookers, fires, water heaters, 'fridges and home laundry equipment.

Now, with the weight of advertising on central heating and tremendous public interest in it, the Southern Gas Board feel that the central heating story can be told at the point of sale and as the sixth card in the trick. In fact, if present trends continue it could well be the trump.

These pictures show an attractive range of displays to suit showrooms and windows of all sizes. They make the 'plus points' for gas simply and directly and help the salesman while interesting the customer.

Top: This neat panel is in colour and well-lit by concealed fluorescent tubes. It tells the story of a ducted air installation by the Board in a £5,000 bungalow.

Centre: Seeking to appeal to the architect and builder, this panel shows what gas has to offer in multi-storey buildings.

Bottom: For the bigger showroom or window a cheerful display which contains some hard selling. Mr. Therm, in the top left hand corner, is mobile.

REFRACTORIES STORY IS FILMED

A FILM has been made about refractories which involves the activities of a British firm, claimed to be the largest producer of refractory materials in Western Europe and the Commonwealth, the Steetley Co. Ltd., of Worksop, Nottinghamshire.

Wherever fire and furnaces are used in the service of mankind refractories are called upon to contain and control the enormous resultant temperatures involved.

The film, *The Steetley Story*, opens with a view from the air of one of the firm's plants. Christopher Chataway introduces the film and speaks the commentary. The film illustrates the acquiring of raw materials and the many processes associated with the manufacture of refractory products.

The thrust-boring machine driving a length of steel piping through the embankment. To the right of the picture can be seen the auger which brings back excavated soil through the piping.

THRUST-BORING

WHAT is believed to be the biggest thrust-boring operation in the country is taking place at Reading for the Southern Gas Board.

Two 380-ft. lengths of 18-in. diameter seamless steel piping are being driven through the embankment 30 ft. below the main railway line system.

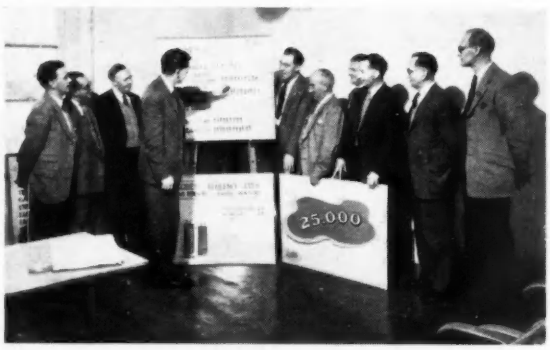
One of the pipelines will carry virgin naphtha from a new store to be built on the King's Meadow side of the railway lines to Reading gasworks. The other will carry central services, such as water and electricity.

The system is expected to be working fully by the end of February. The virgin naphtha will provide a useful alternative feedstock to gas oil.

ROLLS-ROYCE GAS ENGINES

NATURAL gas engines, manufactured by Rolls-Royce, are now being used by two Trinidad petroleum companies, states the Financial Times. *The engines are basically four, six and eight cylinder diesels, modified to work as normally aspirated four-stroke gas engines.*

It is expected that there will be a good market for these engines, particularly in South America where there are large supplies of this cheap fuel.



Mr. J. B. Cronin, Area Safety Officer of the West Midlands Gas Board, illustrates points about accidents to the eight supervisors. On the extreme right is Mr. R. H. Tatlow, the Warwickshire Divisional Safety Officer.

Industrial course held in Glasgow

INDUSTRIAL gas staff of the Scottish Gas Board attended the second industrial course organised by the Board in Glasgow. Lectures were given by speakers from leading industrial companies, and were illustrated by visits to local factories to inspect gas-fired plant.

The course was opened by Mr. A. McFadyen, Divisional Manager, Glasgow and Western Division. The concluding address was made by Mr. H. R. Hart, Deputy Chairman, who reviewed the progress made in industrial sales.

DATES FIXED

The Scottish Gas Consultative Council has arranged dates for all its meetings next year. They will be held in Edinburgh on January 25, April 26, July 26, and October 25.

Sales manager makes 20,000 mile tour

BARBADOS, Antigua, the Dominican Republic, Puerto Rico, Jamaica, Cuba, the Bahamas and New York will all be visited before February by Parkinson Cowan Export Sales Manager Mr. M. Rowledge.

Main purposes of the tour are to promote the appliance sales in areas where natural gas is used, to appoint new agents and to discuss with overseas water engineers the present and future of liquid metering.

Northern Juniors

A meeting of the Northern Junior Gas Association held in Newcastle with its President, Mr. G. E. Haddon in the Chair, heard a paper on the subject 'Opportunity in Prosperity' by Mr. E. Sheldon of Middlesbrough. A vote of thanks was proposed by Mr. R. J. K. Shepherd of Carlisle.

SUPERVISORS LEARN SAFETY MEASURES

ONE-DAY courses for supervisors to demonstrate that safety is also part of their job have been devised by Mr. J. B. Cronin, Safety Officer of the West Midlands Gas Board.

The courses—there will be about 70 of them altogether—recently began at the Board's Warwick Training Centre. Eight supervisors from the Warwickshire Division attended the first one.

Each course is divided into four sessions. It begins with a review of the number of workpeople affected by accidents, the different sorts of accidents, and the effect they have on efficient production.

In the second session slides are used to show situations which have caused, or might cause, accidents. Then follows a 'staged' accident which has to be investigated. There is discussion on its cause, responsibility and how it could have been prevented. Finally, there is a general summing up of the programme.

PERSONAL NOTES

MR. I. J. CROSTHWAITE D.S.O., has been appointed Chairman, and Mr. H. D. WALKER, MR. R. RILEY, MR. H. H. ROSENBROCK and MR. M. P. ATKINSON have been appointed Directors of the Automatic Control Division of Constructors John Brown Ltd., which has been formed into a wholly owned subsidiary company. Mr. Riley will also hold the position of General Manager, and Mr. Atkinson that of Chief Engineer.

MR. K. C. REES, Watford Works Engineer for the Eastern Gas Board, has been Called to the Bar of the Middle Temple. Mr. Rees began as an articled pupil with former Wandsworth undertaking, and was appointed Watford Works Engineer in 1938, at the age of 25.

MR. FRANK KIRKLAND, for many years commercial manager, and more recently assistant secretary of Hattersley and Davidson, Ltd., has been elected a Director. He has been with the Company for nearly 45 years.

MR. ERIC KERSHAW, senior wages clerk at the Bradford office of the North Eastern Gas Board, is emigrating to Australia, where he will join the clerical staff of the Colonial Gas Association at Boxhill, near Melbourne.

MR. E. K. EASTABROOK has been appointed District Manager at Leicester in the Leicester and Northants Division of the East Midlands Gas Board.

Appliances for the farm and for the home were featured on the Gas Council Stand at the Smithfield Show, Earls Court, London.

COMING EVENTS

December 23. — SCOTTISH WESTERN JUNIORS: The King's Theatre, Glasgow. Theatre Outing.

January 3.—I.G.E.: Main Chemistry Lecture Theatre, Imperial College of Science and Technology, London, S.W.7. 'The Production of Fuel Gases,' by C. H. Lewis.

READY FOR THE OVEN

Gas cookers were featured at the British Turkey Federation's Press conference in London, to show how easily they will take the largest of birds.

Housewives will have 4½ mill. of these quick frozen oven-ready birds, as well as large quantities of clean-plucked turkeys, said Mr. John S. Lintern, member of the Federation's management committee, seen here, showing a fine specimen in a Radiation New World 42 cooker to some of the Press.

German News Letter

DURING the month of September the production of gas in the Federal Republic was again rising. Gas consumption was 1,190 mill. cu.m., a rise of 5.5% compared with September 1959. Town gas production for domestic and commercial consumers was 115 mill. cu.m., a rise of 4.2% and for industry, 1,034 mill. cu.m., a rise of 5.8%.

The production of natural gas in Western Germany is steadily rising. In the month of September, production reached 38.2 mill. cu.m., a rise of 28%, compared with the output in September 1959. The output of natural gas has risen from January to September from 271.3 mill. cu.m. to 322.2 mill. cu.m.

The mayors of some of the big towns in Western Germany have accepted an invitation from the International Burgomaster's Union to visit some important production centres of natural gas in the Algerian desert. At Hasi-R'mel, French and German firms extract natural gas from deposits, which are estimated to contain between 500,000 and 800,000 mill. cu.m. of natural gas. Experts have calculated, that reserves of 10,000 mill. cu.m. of natural gas would be sufficient to convert the whole Federal Republic to its use.

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